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THE ETHNOBOTANY OF SWEET FLAG, *ACORUS CALAMUS* (ARACEAE)[1]

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Motley, Timothy J. *(University of Hawaii at Manoa, Department of Botany, 3190 Maile Way, Honolulu, HI 96822-2279).* THE ETHNOBOTANY OF SWEET FLAG, *ACORUS CALAMUS* L. (ARACEAE). *Economic Botany 48(4):397–412. 1994.* *Sweet flag,* Acorus calamus, *one of the few extratropical members of the Araceae, is a semi-aquatic component of aquatic habitats throughout the temperate to sub-temperate regions of Eurasia and the Americas. The plant has a rich ethnobotanical history dating back possibly to the time of Moses in the Old Testament of the Bible and in early Greek and Roman medicine. Sweet flag, thought to be indigenous to India and spread along trade routes, has been valued for its rhizome and fragrant oils which have been used medicinally, in alcoholic beverages, as a fragrant essence in perfumes and oils, and for insecticidal properties. Current research investigates sweet flag's value as an insecticidal, antibacterial and antifungal agent. This paper is a comprehensive survey of the past, present and future uses of sweet flag.*

Calamus, *Acorus calamus,* ethnobotanique. *Calamus,* Acorus calamus, *l'une des rares espèces non tropicales de la famille des Araceae, est une semi-aquatique composante des milieux aquatiques des régions tempérées et sub-tempérées d'Euraore et des Amériques. Cette plante bénéficie d'une riche histoire ethnobotanique datant de l'époque de Moise de l'ancien testament de la Bible et des medecines Romaine et Grecque. Calamus est probablement originaire de la péninsule Indienne et fut distribuée par les commercants pour qui le rhizome riche en huiles aromatiques, sont utilisés en pharmacopée, dans les boissons alcoolisées, la parfumerie et pour ses propriétés insecticides. Actuellement, des recherches sont entreprises pour évaluer les proprietés insecticiden, bactéricide et fongicide de cette espèce. La présente étude fait une synthese des usages et des potentialités de cette espèce (calamus).*

Key Words: *Acorus calamus*; sweet flag, calamus; ethnobotany; alkaloids; essential oils.

Sweet flag, *Acorus calamus* L., is an uncommon but widespread, semi-aquatic plant of aquatic habitats in temperate to subtemperate regions. A herbaceous perennial (Fig. 1), sweet flag has long, erect, narrow, aromatic leaves ascending from a branched, underground rhizome (Fig. 2). The seemingly numerous plants seen above ground in a population probably arise from a single plant connected by an extensive underground rhizome. Internally the rhizome (Fig. 3) is whitish pink in color and pleasantly aromatic, smelling of citrus, although it has a bitter taste. The inflorescence consists of a leaf-like spathe and a spike-like spadix, produced from the middle of the spathe, that is densely covered with yellow and green flowers (Fig. 4).

Sweet flag has traditionally been placed in the Araceae, the arum family, based on morphological similarities between it and other members within the family. However, recent taxonomic studies based upon morphological, anatomical, developmental, and molecular data suggest that *Acorus* be placed in its own monotypic family (Bogner and Nicolson 1991; Duvall et al. 1992; Grayum 1987).

The species has been redefined primarily on the basis of genome differences. *Acorus calamus* var. *americanus* (Raf.) Wulff comprises diploid members that range in distribution from North America to Siberia. The sterile triploid *A. calamus* var. *calamus* (=*vulgaris* L.), is distributed throughout Europe, temperate India, and the Himalayan region, and the tetraploid variety, *A. calamus* var. *angustatus* Bess., is found in eastern and tropical southern Asia including Japan and Taiwan (Bown 1988; Röst 1979).

Sweet flag was included in many early herbals and has a rich history dating back to early Greek and Roman medicine. In addition to its medic-

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Fig. 1. Sweet flag in a semi-aquatic habitat, a river floodplain near Penfield, Illinois.

inal uses, sweet flag was the subject of superstition and poetry, and the fragrant leaves, smelling of tangerine or citrus, were used on the floors of homes and churches to remove disagreeable odors and deter pests. Candied, the rhizome was a European and early American confection.

The plant was initially distributed from its native range through trade and commerce. The rhizome was subsequently cultivated and the plant

Fig. 2. A sweet flag specimen showing foliage, inflorescence, rhizome and roots.

Fig. 3. The peeled, white, internal portion of the sweet flag rhizome prepared for consumption or medicinal use.

spread by vegetative means (Grieve 1971). The rhizomes were utilized extensively by the Chinese, Indians, and American Indians, as well as by other cultures, and many of these uses continue to this day.

Presently, the fragrant oils obtained from the rhizome are used medicinally, as flavoring in alcoholic beverages, as fragrant essences in perfumes and sacred oils, and for insecticidal properties. Research has been initiated on the chemical compounds in the rhizome to determine their

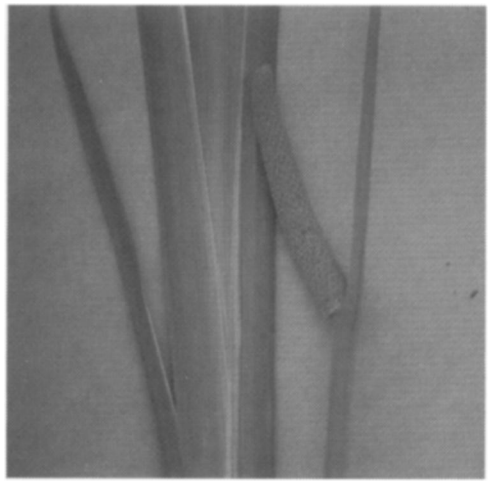

Fig. 4. The spathe and spadix of a sweet flag inflorescence.

usefulness as medicinal, insecticidal, antibacterial, and antifungal agents.

Chemical Composition

The major chemical constituents of the essential oils of sweet flag are phenylpropanes, monoterpenes, and thermolabile sesquiterpenoids (Röst and Bos 1979). Studies of the volatile constituents of sweet flag using gas chromatography and mass spectrometry detected 184 compounds in the oil of the triploid European *A. calamus* var. *calamus* and 93 compounds in the oil of the tetraploid Indian *A. calamus* var. *angustatus,* with β-asarone as the major constituent. These chemical constituents consisted of 67 hydrocarbons, 35 carbonyl compounds, 56 alcohols, eight phenols, two furans and four oxido compounds (Mazza 1985a). Mazza (1985b) also detected, in an alcohol extract of *A. calamus* var. *calamus,* 243 volatile components, 45 of which were new records from sweet flag.

Methyleugenol, cis-methylisoeugenol, β-asarone, geranylacetate, β-farnesene, shyobunone, epishyobunone, isoshyobunone, and an unknown constituent are the most abundant chemical compounds constituting about 20% of the essential oil (Röst and Bos 1979). The other chemical components include α and γ-asarone, calamenene, asaronaldehyde, acorenone, calamenone, n-heptanic acid, calanendiol, numerous sesquiterpenes, and other compounds in trace amounts (Mazza 1985a; Perry and Metzger 1980).

The proportion of each chemical compound in the essential oil varies among the varieties of *A. calamus,* corresponding to the ploidy level of the taxon (Mazza 1985a; Röst and Bos 1979). β-asarone concentrations vary markedly among the oils from the three varieties. The tetraploid plant oil is high in β-asarone (90–96%) and also contains α-asarone. The triploid plants contain a small portion of β-asarone (5%) in their oil and the diploid plants lack β-asarone, but contain high amounts of geranylacetate. Individual plants also show variation in the percentage of chemical components depending on the part of the plant from which the oil was extracted (Röst and Bos 1979).

Chemical isolation studies have led to the discovery that the two stereoisomers, α and β-asarone, have psychoactive effects (Ott 1975). According to Schultes and Hofmann (1980) "the root induces an experience similar to LSD in sophisticated subjects." Native Americans who consumed the root reported that it relieved fatigue and compared the experience to "walking a foot off the ground" (Schultes and Hofmann 1980). In chemical structure α-asarone is similar to mescaline, the alkaloid in the hallucinogenic peyote cactus [*Lophophora williamsii* (Salm-Dyck) J. Coulter] (Lewis and Elvin-Lewis 1977) or amphetamines (Elliott 1976), and β-asarone is chemically like myristicin and kava (*Piper methysticum* G. Forster) alkaloids (Lewis and Elvin-Lewis 1977). The pale yellow to pale brown volatile calamus oil has an odor described as "woody-spicy with increasingly sweet afternotes and great tenacity" that resembles "dried milk or sweet leather, slightly creamy-nutty," and has been compared to the fragrance of a milk-truck or shoe-repair shop (Arctander 1960). This characteristic aroma is derived from the chemical compound (Z,Z)-4, 7-decadienal which is present in the oil at about 100 000 times its odor threshold value (van Lier, van der Linde, and van der Weerdt 1986). This oil and asarone have a relaxing effect on smooth muscle tissue, similar to the effects of papaverine found in the opium poppy (*Papaver somniferum* L.). Tannins, starches, mucin (Thomson 1978), soft gums, and resins are also found in sweet flag (Grieve 1971).

Toxicology

Sweet flag is poisonous under certain conditions, causing disturbed digestion, gastroenteritis, persistent constipation, followed by diarrhea and passage of blood into the feces (Pammel 1911). In 1968 the U.S. Food and Drug Administration reported that the use of sweet flag was unsafe, based upon cancerous tumors found in laboratory animals treated with the plant (Dobelis 1986; Furia and Bellanca 1971). Though the use of sweet flag is prohibited in the United States and Canada, sweet flag is still used traditionally in many European countries to flavor spirits with the recommended limit of 0.1 mg/kg in food and beverages and 1 mg/kg in spirits and spices. Since the European triploid variety contains far less β-asarone than the tetraploid Indian variety, Lander and Schreier (1990) determined that by screening products containing calamus oil for the acorenone and γ-asarone it is possible to determine the variety of the plant from which the oil originated. The carcinogenic agent, β-asarone, seems only to be present in the

triploid and tetraploid varieties of sweet flag. The diploid varieties lack β-asarone and other toxic phenylpropane derivatives (Duke and Ayensu 1985; Lander and Schreier 1990; Mazza 1985a; Röst and Bos 1979) which may present a possible solution to this problem. The volatile oil, when in contact with the skin, has been known to cause dermatitis in some cases (Mitchell and Rook 1979).

Etymology

A variety of names has been associated with sweet flag. The large number of names attributed to this plant attests to its rich history and use by many cultures in the past. Some of the English folk names include calamus, sweet rush, sweet root, sweet cane, gladdon, sweet myrtle, myrtle grass, myrtle sedge, cinnamon sedge (Grieve 1971), flagroot, myrtle flag, sweet cinnamon (Angier 1974), beewort, pine root, drug sweet flag (Elliott 1976), sweet segg (Harding 1966), sweet grass (Lucus 1966), reed acorus, sweet flagroot (Krochmal and Krochmal 1975), water flag, yellow flag (Simmonite and Culpeper 1957), rat root, and sweet calomel (Schultes and Hofmann 1980).

Many of the common names were derived from the appearance of the plant's long, sword-like foliage. The term "flag" refers to the drooping, prostrate, iris-like leaves. Yellow flag (*Iris pseudoacorus* L.) and blue flag (*I. versicolor* L.), two species of the Iridaceae, are often mistaken for sweet flag in the vegetative state. Sweet flag has also been called a rush, grass, reed, cane, sedge, and myrtle, due to the similarity of sweet flag foliage to that of representatives from other families.

The term "sweet" refers to the pleasantly aromatic odor of the plant. The economic utilization of the rhizome led to the application of the common names sweet root, rat root, pine root, and flag root, which incorrectly refer to the underground rhizome as a root.

History and Folklore

One of the earliest records of sweet flag is the calamus of the Bible. It was first mentioned when God told Moses to make a holy oil to anoint the tabernacle, the ark of testimony, and other ritual paraphernalia (Moerman 1981). In the wilderness Moses received instructions to use myrrh, frankincense, cinnamon, calamus, cassia, galbanum, and sweet spices in the making of the holy oil (Exodus 30:23, 24, 34). Calamus was also one of the plants said to grow in the gardens of Solomon (Solomon 4:14). It was later mentioned (Ezekiel 27:19) as one of the market plants of Tyre. There are some differences of opinion as to whether the calamus mentioned is *Acorus calamus*. Some scholars believe that the calamus of the Bible actually refers to beardgrass (*Andropogon aromaticus* L.) (King 1941) or to lemon grass (*Cymbopogon* sp.) (Wheelwright 1974).

The remains of sweet flag were one of many plants found in the tomb of King Tutankhamen (Bown 1988). Sweet flag was also used by the early Greeks and Romans. Hippocrates (460–377 B.C.) used the plant medicinally (Mabberley 1990), and in early herbals of the first century Dioscorides and Pliny referred to a plant called *acoron,* which appears to be sweet flag (Grieve 1971). Theophrastus (371–287 B.C.) mentioned calamus in his works, and Celsus reported its presence in Indian markets nearly two thousand years ago (Lloyd 1929). In India sweet flag was such an important medicinal aid for children's stomach complaints and colic that the *Materia Medica of Hindoostan* of 1813 mentioned a penalty imposed on any druggist who refused to open the door of his business in the middle of the night to a parent in need (Barton and Castle 1877).

Aphrodisiac properties were attributed to the rhizome by the Roman and Arabic cultures for centuries (Connell 1965). Its reputed ability to arouse sexual desire resulted in sweet flag being tagged with the name "Venus plant" (Wedeck 1960). Sweet flag was one of many ingredients used in a love potion in medieval times, prescribed by the physician Zacutus the Portuguese (Connell 1965).

In the eleventh century sweet flag, a native of China and India, was transported into Russia and Poland by the Tatars during their conquests. The Tatars believed that sweet flag purified drinking water, and for this reason they carried and planted sweet flag in their new settlements. Sweet flag soon became a symbol of Mongol (Tatar) invasion and was referred to as "Tatar" or "Mongolian Poison" by the natives of the conquered territories (Elliott 1976). The first record of sweet flag cultivation was in 1574 by the Austrian botanist Clusius, who obtained a rhizome from Asia Minor and propagated it in Vienna (Grieve 1971). The plant was soon reported in many other European countries. In 1588 it was

first recorded in Germany (Elliott 1976), was cultivated by Gerard in England in 1596, and was then introduced into France, Belgium (Grieve 1971), and other countries by way of exchanges between botanists, botanical societies, and botanical gardens.

Sweet flag was soon recognized as being useful and quickly gained a place in European history and superstition. It was thought to be one of the ingredients in the hallucinogenic "flying ointments" used by European witches (Ott 1975). The fragrant leaves of sweet flag were used in medieval times on the floors of castles, churches and cottages to help cover odors and repel insects resulting from poor sanitation (Dobelis 1986). Many churches used the leaves during holidays and festivals and the churches in Norfolk, England were thatched with the foliage (Grieve 1971). During the reign of Henry VIII in England, Cardinal Wolsey was brought up on the charges of extravagance, not due to his extensive land ownings but to his habit of importing, at great expense, sweet flag reeds from the faraway counties of Norfolk and Suffolk for his church in London. He was found guilty and beheaded (Elliott 1976).

During the time of the plague in Europe, when people avoided the sick and dead in order to avoid contracting the disease, a band of thieves was robbing the homes of infected people without being stricken by the disease. When the thieves were finally caught and brought to trial they were offered an acquittal if they would reveal the secret of their immunity. The mixture they drank and doused themselves with before their crimes came to be known as the "Vinegar of the Four Thieves." The potion contained beach and roman wormwood, rosemary, sage, mint, rue, lavender flowers, calamus powder, cinnamon, cloves, nutmeg, and garlic. The ingredients were then placed in a crock and red wine vinegar poured over it, then left in the sun for several weeks and distilled off, followed by the addition of camphor (Clarkson 1939).

Many North American Indian tribes used sweet flag either drunk as a decoction, or chewed raw or smoked to fight fatigue and hunger, much in the same way that South American Indians have used coca (*Erythroxylum coca* Lam.) (Ott 1975). Medicinally some tribes chewed the rhizome daily as a panacea (Moerman 1981).

Early American settlers found many uses for the plant. Pieces of the rhizome were carried in a pocket to protect the possessor from being struck by lightning. An amulet formed from the rhizome was thought to protect the wearer from infectious diseases (Ruegg 1936). Grieve (1971) recounts that *Salmon's Herbal* of 1710 stated that there were sixteen ways in which the rhizome could be prepared medicinally: "as a liquid juice, an essence, an infusion of wine, a decoction of wine, a powder, a cataplasm, a spirituous tincture, an acid tincture, an oily tincture, a spirit, a chemical oil, potestates or powders, an elixir, a collegium, a preserve and a syrup." The Shakers and other New Englanders sold the candied "root" as a confection, which was still to be found in specialty shops by Fernald and Kinsey (1943). In astrological classification sweet flag was placed under the moon sign because of the half-moon shape and yellow color of the inflorescence and the plant's aquatic habit (Lust 1974). The distinctive shape of the flowers and rhizomes of sweet flag probably inspired the "calamus cluster" of thirty-nine poems written by Walt Whitman in the *Leaves of Grass* (Whitman 1965). This group of poems is thought to be about what Whitman called "adhesiveness . . . a personal attachment between men that is stronger than ordinary friendship" (Moerman 1981).

Ethnobotany

Since sweet flag was, and continues to be, used by many different cultures and in many different countries, the ethnobotanical uses are listed by country, ethnic group, or region.

Arabic Cultures. The rhizome has been regarded as an emmenagogue, an excitant, a stomachic, a diaphoretic, a diuretic, an incisive, and an aid for flatulence, vertigo, and headaches arising from dyspepsia (Barton and Castle 1877). Sweet flag, or in Arabic, *vash* or *vaj* (Caius 1986), was an ancient remedy for "burning water" rising from the stomach to the throat. Ancient Egyptians used sweet flag to treat scrofula (Clymer 1963).

Argentina. The Spanish names for the plant are *acoro* and *acoro verdadero* (Caius 1986) and women are given the rhizome for painful menstruation (Manfred 1947).

Brazil. Medicinally sweet flag has been used as an anthelmintic (Watt and Breyer-Brandwijk 1962). The Portuguese names for sweet flag are *calamo aromatico* and *canna cheirosa* (Caius 1986).

China. The plant is called *ch'ang, ch'ang-p'u, shui-ch'ang-p'u, ch'ang-jung,* and *pai-ch'ang,* depending on the variety (Shih-Chen 1973), and the rhizome is recommended for inflammation of the gastric membrane, colic, and as an appetite stimulant (Wallnofer and Rot-

tauscher 1965). It is known for its attributed qualities as a smooth muscle relaxant, central nervous system depressant, hypotensive, anticonvulsant, hypothermic, analgesic, sedative, contraceptive, antipyretic, antidiarrheal, anthelmintic, antirheumatic, antiemetic (Anonymous 1975), diuretic, carminative, laxative, emetic (Agarwal et al. 1956), and as a lotion for leprous or pustular sores (Duke and Ayensu 1985). Sweet flag is listed as an insecticide, an antifungal agent, an antibacterial agent, and a fish toxin (Anonymous 1975). The rhizome was also prized for use in cases of bronchitis, coughs, colds, arthritis, dyspepsia, epilepsy, nausea, stroke, antiarrhythmia, and as an antiveratric (Duke and Ayensu 1985).

Powdered, the rhizome is used to treat buboes, carbuncles, deaf ears, sore eyes, anorexia, and abdominal and chest congestion. The powdered rhizome is said to act as a diaphoretic, an expectorant, and, due to the presence of coumarins, as a cure for tuberculosis (Duke and Ayensu 1985) as well as lung and heart cancer (Kirtikar, Basu, and I. C. S. 1975).

The rhizome is said to act as a desiccant for treating neurological symptoms of the brain (Perry and Metzger 1980) and inhalations are used to treat headaches (Boissya and Majumder 1980). A water mixture of the rhizome with the crushed stems of *Coccinia cordifolia* Cogn. is used for high fever and vertigo. When combined with *Alpinia galanga* (L.) Willd., *Zingiber purpureum* Rosc., and vinegar, the rhizome has been used as a depurative for women. Herbal baths of sweet flag have been said to stimulate the circulation as well as giving relief to patients with rheumatism and lumbago (Perry and Metzger 1980). Boissya and Majumber (1980) mention application of a paste made out of the rhizome to stop the bleeding of external injuries.

In China aphrodisiac properties have been attributed to the plant (Dragendorff 1898) and it was also used in a potion in order to hallucinate or "see spirits." The latter was accomplished by mixing the rhizome with the achenes of *Cannabis sativa* L. and with *Podophyllum pleianthum* Hance (Li 1977). The leaves of sweet flag and *Artemisia vulgaris* L. are used as a charm during the dragonboat festival. On the fifth day of the fifth moon the leaves are hung on the doors of homes to ward off evil spirits (Shih-Chen 1973).

England. Sweet flag has been utilized as an aromatic, a carminative, a stomachic (Wren 1956), an appetite stimulant, and an antibacterial agent (Grieve 1971); also to relieve flatulence, colic, dyspepsia (Wren 1956), ague (Wheelwright 1974), and high fever (Grieve 1971). Colic has been treated by combining the rhizome with magnesia and chalk (Wren 1956). Inhaled, the oil treats low fever and dyspepsia and clears the voice. In Norfolk, sweet flag was used as a cure for a fever prevalent in the fens and as a stimulant in typhoid cases. A tonic called stockton bitters, made of sweet flag and *Gentiana campestris* L., is used for nervous complaints, vertigo, headaches, dysentery, and catarrh (Grieve 1971).

Europe. Sweet flag has been used to prevent obesity, enhance digestion, aid colds (Moerman 1981), induce menses (Jochle 1974), and as a carminative (Watt and Breyer-Brandwijk 1962). The rhizome was chewed as a masticatory to clear the voice (Barton and Castle 1877) and powdered to flavor beef and snuffs (Barton and Castle 1877). It has been added to toothpaste (Lewis and Elvin-Lewis 1977), perfumes, toilet powders, and sachets (Hill 1952).

France. Sweet flag (*acore, acore aromatique, acore odorant, acore vrai, acori, acrois, galanga des marais, roseau aromatique, roseau odorant* (Caius 1986)) has been used in beers, to scent the snuff a' la violette, and as an addition to some perfumes (Barton and Castle 1877).

Germany. The German names for the plant are *ackermagen, deutscher ingber, gewuerzkalmus, kalmus, karmes, karmsen, kaumeles, kolmas, magenwurz, nagenwurz, schiemen, schiemenwurz, wechel,* and *zehrwurzrhizome* (Caius 1986). The rhizome has been sold as a "quack" emmenagogue (Kantor 1916) and as treatment of gastrointestinal ailments (Herrmann 1956). A recent immigrant from Germany recalls the plant being used as incense during Easter in the Lutheran church during the 1950s.

Holland. Children chew the rhizome like a gum and make pop-gun projectiles out of it (Grieve 1971). In the Netherlands the plant is called *kalmus* and *zwanenbrood* (Caius 1986).

India, Pakistan and Ceylon. Acorus calamus is called *bach, ghorabach,* and *safed-bach* in Hindi, *themeprü* in Assamese, *bach* in Bengali, *ganghilovaj* in Gujarati, *bajegida* in Kannada, *vashampe* in Malayalam, *vekhand* in Marathi, *bhuta-nashini* in Sanskrit, *vasambu* in Tamil, and *vasa* in Telugu (Jain 1968). The rhizome is used as an aromatic stimulant, an expectorant, an emmenagogue, a bitter tonic, a carminative, an antispasmodic, an emetic, a laxative, a diuretic (Dastur 1951), a central nervous system relaxant, a stomachic (Satyavati, Raina, and Sharmal 1976), an appetite stimulant, an anthelmintic, a vermifuge, an antibacterial agent, a sedative, an analgesic (Jain 1968), and a contraceptive (Malhi and Trivedi 1972). It is also used for ailments such as mouth and throat diseases, fevers, epilepsy, bronchitis, delirium, hysteria, tumors, thirst, memory loss, rat bites, ear worms, general weakness, toothaches, pains of the chest and kidneys, leucoderma (Kirtikar, Basu, and I. C. S. 1975), asthma, diarrhea, dysentery, flatulence (Jain 1968), dyspepsia (Wren 1956), indolent ulcers (Dastur 1951), rheumatism (Arseculeratne, Gunatilaka, and Panabokke 1985), and to increase the rate of catabolism (Lewis and Elvin-Lewis 1977).

Dastur (1951) states that in the treatment of children an infusion of the rhizome is given to aid in the relief of choleric diarrhea, dysentery, bronchitis, cough, fever, dyspepsia, epilepsy, and intestinal worms. He also states that the burnt rhizome is given to infants for

diarrhea, teething, colic, and as an emetic, and that the oil is used as an expectorant and relieves asthma, dysentery, loss of appetite, catarrh, ague, and hysteria. Dastur also mentions its use as a mild stimulant in typhoid cases, and a preparation mixing sweet flag with *Cinchona* L. bark for intermittent fever. The oil is given to hemorrhaging women after an abortion, and it is also used as a vermifuge to counteract croton poisoning. Mixed with saffron and mare's milk, it is administered to hasten delivery during childbirth. The rhizome is sucked as a lozenge for coughs, sore throat, and to clear the voice. A poultice of the burnt rhizome is mixed with castor oil or coconut oil, and milk or cashew spirit, for the treatment of abdominal cramps, paralyzed limbs, and rheumatic swellings.

In times of epidemics the rhizome was chewed to protect the user from disease (Barton and Castle 1877). It was also thought to be an aphrodisiac (Petelot 1954). The markets of India sell the candied "root," which can be eaten as a confection or used as a spice substitute for ginger (Meyer 1970). A hair perfume is prepared from the powdered rhizome (Ruegg 1936).

The plant has also been used as an insecticide to repel fleas and protect clothes and grain from moths (Watt and Breyer-Brandwijk 1962) and the powder was sprinkled around the bases of trees to protect them from infestation by white ants (Dastur 1951).

The rhizome, mixed with garlic, cumin seeds, salt, sugar, and butter, was used in veterinary medicine to strengthen horses. It is one of the ingredients used in the treatment of foot-and-mouth disease (Watt 1908) and the plant was believed to have a narcotic effect on cobras (Watt and Breyer-Brandwijk 1962).

Tibet. Dried sweet flag, mixed with *Ferula foetida* (Bunge) Regel, *Zingiber officinale* Rosc., *Cuminum cyminum* L., *Terminalia chebula* Retz., *Inula racemosa* Hook., and *Saussurea lappa* C. B. Clarke, is used to treat choleric diarrhea, chronic fever, heaviness of the stomach, and phantom tumor (Lama and Santra 1979). The dried plant is used in cancer cases (Burang 1979), and in Nepal the rhizome is valued for its use against colds, coughs, bronchitis, and nervousness (Singh et al. 1979).

Indonesia. Sweet flag has been used to treat diarrhea, as a postpartum to "purify" women after childbirth, and to rid the body of lice (Hirschhorn 1983).

The Isle of Man. Manxmen, on holidays, strew the floors of houses with the leaves of sweet flag (Gibbons 1962).

Java. The rhizome is taken after childbirth to increase the flow of milk (Burkill 1966).

Lithuania. The rhizome has been preserved as a sugar confection and the young leaves eaten by children (Grieve 1971). The Lettish people drank a brandy extract of the rhizome for chest pain and diarrhea. The leaves have been added to baths to relieve pain, sterility, gout, and rheumatism. The leaves were placed in beds to rid them of fleas (Ruegg 1936).

New Guinea. Sweet flag has been used to induce abortions (Krochmal and Krochmal 1975).

Philippines. Sweet flag has been valued as a diaphoretic, an antidyspeptic (Diguangco 1950), a stimulant, a carminative, and as an embrocation in rheumatism (Watt and Breyer-Brandwijk 1962). Powdered rhizome has been used in sachets and toilet preparations (Diguangco 1950). Local names for the plant include *lubigan, acoro, bueng, dálau, dárau,* and *déngau* (Quisumbing 1951).

Russia. The rhizome was used to cure typhoid fever, cholera, syphilis (Ruegg 1936), and baldness (El'Yashevych and Cholii 1972).

South Africa. Watt and Breyer-Brandwijk (1962) state that the white population uses sweet flag as a carminative, a stomachic, an antidiarrheal, a tonic, a tooth powder, and an aphrodisiac.

Sweden. A rhizome extract of the plant they call *kalmus* has been used in corn spirits (Barton and Castle 1877).

Thailand. The rhizome has been taken for blood purification and as an antipyretic (Mokkhasamit et al. 1971).

Turkey. The oil of the rhizome has been used as an antiseptic to prevent infection (Ruegg 1936). The candied or fresh rhizome has been chewed as a confection, a stomachic (Harris 1972), and to aid dyspeptic patients (Wren 1956). Baked, the rhizome has been used for coughs, tuberculosis (Ruegg 1936), and as a preventive medicine during epidemics (Barton and Castle 1877). In Istanbul the rhizome was a confection and stomachic, and was eaten during epidemics as a preventive medicine (Lindley 1838).

United States. The rhizome is used for stomach cramps, flatulence, and as a stimulant tonic (Dobelis 1986). Chewed raw or candied, it clears phlegm from the throat (Krochmal and Krochmal 1975), is used to treat indigestion and heartburn, and as a carminative (Elliott 1976). It is also employed for appetite loss, biliary upsets, liver disorders, exhaustion, weakness (Thomson 1978), high cholesterol (Harris 1972), diarrhea, fevers (Ludlow 1924), suppressed menses (Tantaquidgeon 1972), malaria (Ruegg 1936), and toothaches (Hussey 1974). It is used as a vermifuge (Malpass 1945), an antiseptic, an antiprotozoal agent, a central nervous system stimulant, a sedative, an analgesic, a tonic for lowering blood pressure and respiration (Watt and Breyer-Brandwijk 1962), and, in Missouri, as an abortifacient (Weiner 1972). Dropsy, peritonitis (Bethel 1972), hyperacidity, and pyrosis are also said to be cured by the rhizome.

Sweet flag is high in potassium, which has suggested its use in the relief of illnesses which have been attributed to potassium deficiency, such as asthma, hay fever, hiccups, and muscular dystrophy. The phosphorus and potassium in the plant also aid in pain relief (Bethel 1972). Harris (1972) remarks that the rhizome stores unused carotene, which is converted to vitamin A and

can be used to treat eye problems. The sulfur content in the rhizome has been suggested as favorable for bone growth, blood clotting, muscle metabolism, and to counteract toxic substances in the body (Lust 1974).

Externally the rhizome is used to wash sores, burns (Elliott 1976), and indolent ulcers (Morton 1974). In a bath the plant has been used for rickets, scrofula, paralysis, gout (Ruegg 1936), poor circulation, chilblains, low blood pressure, and general tiredness (Lust 1974).

The powdered rhizome was smoked or chewed to help smokers quit cigarettes (Dobelis 1986) and was sprinkled on shelves or in closets to repel insects and protect clothes and books (Barton and Castle 1877).

The oil is used to flavor cordials, liquors, gin, beer, wine, bitters, and perfumes (Uphof 1968); Vermouth de Turin and Eceu-de-view de Dantzig are examples of liquors flavored with the oil (Ruegg 1936). The oil has fixative properties, which help retain and prolong the aromatic principles of other oils (Meyer 1970).

In Boston the candied rhizome has been chewed to sweeten the breath (Hedrick 1919). The tender new leaves are used in wild salads (Angier 1974), broths, and stews, to flavor fish, and as an additive spice to flavor vinegar (Harris 1972). Loewenfeld and Back (1974) state that some types of creams and custards also contain sweet flag in the flavoring.

In some western states the oil of sweet flag is used in the tanning of leather (Morton 1974). Because of its aromatic odor the plant is used in potpourris (Rose 1974) and sachets (Bethel 1972). *Salmon's Herbal* reported that the juice of sweet flag could be used to "prevail against the bitings of mad dogs and other venomous creatures" (Grieve 1971).

American Indians. Throughout its range sweet flag is used as a cold remedy, cough medicine, general tonic, pain killer for colic, stomach cramps, sore throat, toothache (Moerman 1981), fever, menstrual problems (Dobelis 1986), flatulence, stimulant (Krochmal and Krochmal 1975), kidney problems (Coon 1960), and as an abortant (Weiner 1972). A single dose is a piece of the raw rhizome as big as the first finger joint. The juice of the plant is rubbed directly onto burns and was snuffed for a catarrh (Coon 1960). To relieve fever, coughs, and toothaches the rhizome is mixed with willow bark (Hussey 1974). Sweet flag is considered by many tribes as a cure-all (Johnson 1970) and was used as a medium of exchange (Dobelis 1986).

The Cree of Alberta, Canada, are said always to have carried some of the rhizome in their medicine bundles (Johnson 1970), and they chewed it daily to maintain good health (Anonymous 1981) and prevent fatigue. One daily dose is about 1–2 inches of the rhizome, and ten inches are to be consumed to induce hallucinations (Ott 1975). *Wehkes* (muskrat root), as they call it, is used to treat colds, toothaches, stomach problems (Anonymous 1972), coughs (Kirtikar, Basu, and I. C. S. 1975), cholera (Chandler, Freeman, and Hooper 1979), sore throat, and, when it is mixed with tobacco and smoked, headaches (Johnson 1970).

The Potawatomis snuff the powdered rhizome to stop nasal drip (Weiner 1972) and treat catarrh, and inhale the smoked rhizome to cure colds (Lewis and Elvin-Lewis 1977).

The Blood Indians, who obtained the rhizome from the Kootenai tribe, call it *Pow-e-men-artic* (fire root, bitter pepper root, fish backbone, muskrat root), and use it to relieve coughs and treat liver ailments (Anonymous 1972).

The Meskwakis use the boiled rhizomes on burns and sores (Weiner 1972). The Meskwakis and the Omaha tribe feed the plant to ailing horses (Watt and Breyer-Brandwijk 1962). Kindscher (1987) states that the Omaha eat the boiled rhizome for food.

The Pawnee call the plant *kahtsha itu* (medicine lying in water). The Osage call it *peze boao ka* (flat herb) and the Lakota name is *sinkpe tawote* (muskrat food root) or *sunkace* (dog penis). The Pawnee use a garland of the leaves in sacred ceremonies, and both they and the Lakota braid the leaves into necklaces when they come across the plant during hunts. The Lakota eat all parts of the plant as a salad and the Osage chew the rhizome for flavor (Kindscher 1987). The Dakota, Omaha, Pawnee, and Winnebago tribes all chew the rhizome to soothe toothaches and coughs, and drink it as a tea to lower fevers (Moerman 1981). Dakota warriors chewed the rhizome into a paste and rubbed that onto their faces in the belief that this makes them calm and unafraid in the face of danger during war (Elliott 1976).

On the Sisseton Indian Reservation in South Dakota sweet flag rhizome is mixed in a decoction with another plant root, the identity of which was not revealed, to take the place of insulin (Fielder 1975).

Sweet flag, thought to be a panacea by the Micmac, Cheyenne, and Mohecan, was used to prevent illness and to help ill people regain their strength (Moerman 1981). The Cheyenne used the plant as a diuretic and laxative (Hart 1981) and tied a piece of the rhizome to their children's pajamas to keep the "night spirits" away (Moerman 1981).

The Chippewa called the plant *wiken* or *nabuguck* (Densmore 1974) and snuffed the ground rhizome and drank a tea made from the rhizome to treat colds. The tea was gargled for sore throats (Moerman 1981) and the rhizome used as a physic and cure for toothaches. The Chippewa combined sweet flag with *Aralia nudicaulis* L. in a decoction that was used as a charm on fishing nets and to ward off rattlesnakes (Densmore 1974).

Penobscot Indians held sweet flag to be a panacea (Speck 1917), the Kentucky Algonquin used the plant to induce menstruation (Bolyard 1978), and the Pillager Ojibwas drank the rhizome tea for colds and throat problems (Weiner 1972). Plant parts of sweet flag were discovered in the caves of the Ozark Bluff-dwellers,

evidence that sweet flag was used by them (Kindscher 1987).

Yugoslavia. Peasants have used sweet flag to induce abortions (Krochmal and Krochmal 1975), clear the voice (Barton and Castle 1877), and powdered to toilet powders, and sachets (Hill 1952).

Review of Experimental Data

The cortex of the rhizome of *Acorus* has been shown to act as an antispasmodic agent in guinea pig iliums (Itokawa et al. 1983). A dried extract from *Acorus* was reported by Dash, Tripathi, and Singh (1983) to have psychotrophic activity in humans and to be an effective antifungal agent against the species *Botrytis cinerea* Pers. and *Trichophytum mentagrophytes* (Robin) Blanch. The extract was ineffective against the fungal species *Aspergillus fumigatus* Fres., *Aspergillus niger* Van Tieg, *Candida albicans* (Robin) Berkhout., *Fusarium oxysporum* Schlecht., *Rhizopus nigricans* Ehren., *Penicillium digitatum* Sacc., and *Saccharomyces pastorianus* Hansen.

The essential oil of sweet flag had positive results as an antibacterial agent against *Bacillus pumilus* Meyer & Gottheil in Gottheil, *Bacillus subtilis* (Ehrenberg) Cohn, *Escherichia coli* (Migula) Castellani & Chalmers, *Corynebacterium diphtheriae* (Krause) Lehmann & Neumann, *Pseudomonas solacearum* (Smith) Smith, *Salmonella typhosa* Borman, Stuart & Wheeler, *Sarcina lutea* Pansini, *Shigella diphtheriae* (Shiga) Castellani & Chalmers, *Staphylococcus albus* Rosenbach, *Staphylococcus aureus* Rosenbach, *Streptococcus faecalis* Andrews & Horder, *Streptococcus pygenes* Rosenbach, and *Vibrio cholera* Pacini. The essential oil was inactive on *Pseudomonas aeruginosa* (Schroeter) Migula (Kar and Jain 1971). The oil was reported to be an effective antifungal agent on *Alternaria tenuis* Nees (Arora and Pandey 1984), *Aspergillus fumigatus, A. nidulans* Eidam, *A. oryzae* (Ahlb.) Cohn (Alankararao and Rajendra Prasad 1981), *Diplodia natalensis* Evans (Arora and Pandey 1984), *Penicillium digitatum, P. italicum* Wehmer, and *Phomopsis destuctum* Rao, Agarwal & Saksena (Alankararao and Rajendra Prasad 1981). *Acorus* oil affects spasmolytic activity in rabbit intestines (Kar and Jain 1971) and aorta, as well as in rat intestines and uteri (Maj, Malec, and Lastowski 1966). It is reported effective as an antileech agent (Saxena, Khalsa, and Pillai 1969), for hypotensive relief in cats (Kar and Jain 1971), and as an anticonvulsant in pregnant mice, but was ineffective on male mice (Khare and Sharma 1982).

The dried rhizome of *Acorus* has been reported as an effective antibacterial agent for *Bacillus subtilis* (Janssen et al. 1986; Pongpan, Chumsri, and Taworasate 1982), *B. proteus* Trevisan, *Escherichia coli* (Alankararao and Rajendra Prasad 1981; Janssen et al. 1986), *Hemophilus pertussis* Holland, *Shigella dysenteriae* (Shiga) Castellani & Chalmers (Alankararao and Rajendra Prasad 1981; Chopra, Khajuria, and Chopra 1957), *Staphylococcus aureus* (Janssen et al. 1986), *Streptococcus pneumoniae* (Klein) Chester and *Vibrio cholera* (Chopra, Khajuria, and Chopra 1957), but is ineffective on *Bacillus subtilis* (Ishii et al. 1984; Mokkhasamit et al. 1971; Ray and Majumdar 1976), *Enterobacter agglomerans* (Beijerinck) Ewing & Fife (Grabowska and Kedzia 1982), *Escherichia coli* (Ishii et al. 1984; Mokkhasamit et al. 1971), *Mycobacterium tuberculosis* (Zopf) Lehmann & Neumann (Bhakuni et al. 1969), *Pseudomonas aeruginosa* (Janssen et al. 1986), *Salmonella typhosa* (Avirutnant and Pongpan 1983; Ray and Majumdar 1976), *Shigella dysenteriae* (Avirutnant and Pongpan 1983), *Staphylococcus aureus* (Avirutnant and Pongpan 1983; Bhakuni et al. 1969; Chopra, Khajuria, and Chopra 1957; Mukerjea and Govind 1960; Ray and Majumdar 1976), *Streptococcus pygenes* (Chopra, Khajuria, and Chopra 1957), and *Vibrio cholera* (Ray and Majumdar 1976).

As an antifungal agent, the dried rhizome is active against *Candida albicans* (Janssen et al. 1986), *Lenzites trabea* Pers.:Fr. [=*Gloeophyllum trabeum* (Fr.) Murrill], *Lentinus lepideus* (Fr.:Fr.) Fr., and *Polyporus versicolor* L.:Fr. [=*Trametes versicolor* (L.:Fr.) Pilat.] (Maruzzella, Scrandis, and Grabon 1960), and inactive against *Aspergillus niger* (Ray and Majumdar 1976), *Candida albicans* (Avirutnant and Pongpan 1983; Ray and Majumdar 1976), *Saccharomyces cerevisiae* Hansen, *Trichophytum mentagrophytes, Trichophytum rubrum* (Cast.) Sabour. (Ray and Majumdar 1976) and the potato pest *Phytophthora infestans* (Mont.) de Bary (Yang and Tang 1988).

The dried rhizome has insecticidal properties that are active upon *Aedes aegypti* L. (Dixit, Perti, and Agarwal 1965), *Anopheles maculipennis* Meig. (Mironov 1940; Yang and Tang 1988), *Bombyx mori* L. (Mukerjea and Govind 1959, 1960), *Bruchus chinensis* L. (Yadava 1971), *Chilo suppressalis* Walker (Yang and Tang 1988), *Dacus cucurbitae* Coq. (Kaul and Bhatia 1965), *Dys-*

dercus koenigii F. (Bhaskar et al. 1977; Bhaskar, Saxena, and Srivastava 1972; Koul, Tikku, and Saxena 1976; Saxena et al. 1977), *Henosepilachina vigintiotopunctata* F. (Tewari and Krishna-Moorthy 1985), *Heterotermes indicola* Wasmann, *Letheticus oryzae* Waterhouse (Paul, Agarwal, and Ausat 1965), *Musca domestica* L. (Chopra, Khajuria, and Chopra 1957; Mironov 1940; Mukerjea and Govind 1959, 1960; Saxena and Mathur 1976), *Nephotettix impicticeps* Ishihara, *Rhopalosiphum maidis* F. (Yang and Tang 1988), *Sitotroga cerealella* Oliver (Abraham et al. 1972), *Sitophilus oryzae* L. (Paul, Agarwal, and Ausat 1965), *Spodoptera litura* F. (Yajima, Kato, and Munakata 1977), *Tetranychus urticae* Koch (Yang and Tang 1988), *Thermobia domestica* Packard (Motl, Rohdendorf, and Saxena 1975), and *Tribolium castaneum* Herbst (Paul, Agarwal, and Ausat 1965), but is inactive on *Ixodes ricinus* L. (Mironov 1940). Subrahmanyam (1942) also reported the rhizome powder effective against bird-lice, bed bugs, and clothes moths.

The dried rhizome exhibited no antiviral activity when tested on Influenza A2, Herpes virus type, Polio virus II, and Vaccinia (Bhakuni et al. 1969; May and Willuhn 1978). It also lacked antitumor activity when tested on Leuk-L1210 and Sarcoma-WM256 (Bhakuni et al. 1969). The rhizome gave positive results as an antiamebic agent when tested on *Paramecium caudatum* Ehrbg. (Chopra, Khajuria, and Chopra 1957) and negative results for *Endameba histolytica* Schaudinn (Bhakuni et al. 1969). The nematode *Ascaris lumbricoides* L. was controlled by the dried sweet flag rhizome (Feroz, Khare, and Srivastava 1982; Kokate et al. 1980). The rhizome was found to have mutagenic activity on *Salmonella typhimurium* (Loeffler) Castellani & Chalmers (Goggelmann and Schimmer 1983) and antifolic activity on *Lactobacillus casei* (Orla-Jansen) Hansen & Lessel (Patil, Chitre, and Sheth 1966).

When tested on laboratory animals, the dried rhizome was effective as an antispasmodic (Bhakuni et al. 1969; Bose et al. 1960; Dandiya and Cullumbine 1959; Das, Malhotra, and Dhalla 1962; Keller, Odenthal, and Leng-Peschlow 1985; Updyke 1977), an antihistamine (Updyke 1977), an anticonvulsant (Agarwal et al. 1956; Athanassova, Shopova, and Roussinov 1965; Khare and Sharma 1982), an antipyretic (Maj, Lastowski, and Lukowski 1965), a neuroleptic enhancer (Dandiya and Cullumbine 1959; Dandiya, Cullumbine, and Sellers 1959; Dhalla and Bhattacharya 1968; Malhotra et al. 1961; Malhotra, Das, and Dhalla 1962), a central nervous system depressant (Agarwal et al. 1956; Bhattacharya 1968; Dandiya, Baxter, and Cullumbine 1958; Dandiya and Cullumbine 1959; Dandiya et al. 1959; Dasgupta, Patra, and Sikdar 1977; Maj, Danuta, and Lastowski 1964; Maj, Lastowski, and Lukowski 1965; Shipotshliev 1968), a convulsant (Chopra, Khajuria, and Chopra 1957; Dandiya and Cullumbine 1959; Meunier and Cadeac 1890), a smooth muscle relaxant (Agarwal et al. 1956; Das, Malhotra, and Dhalla 1962), and a uterine relaxer (Dandiya, Cullumbine, and Sellers 1959; Das, Malhotra, and Dhalla 1962; Updyke 1977); it also acted as a carcinogen (Goddard 1968; Taylor et al. 1967; Updyke 1977). The rhizome also shows activity as a hypothermic (Bhakuni et al. 1969; Dandiya and Cullumbine 1959; Maj, Danuta, and Lastowski 1964), a hypotensive (Agarwal et al. 1956; Bose et al. 1960; Dandiya and Cullumbine 1959; Maj, Danuta, and Lastowski 1964; Maj, Lastowski, and Lukowski 1965; Mokkhasamit et al. 1971), an analgesic (Agarwal et al. 1956; Maj, Danuta, and Lastowski 1964), an anti-inflammatory (Vijayasarathy, Sharma, and Prakash 1981), a bronchodilator (Bose et al. 1960), a hepatotoxin (Taylor et al. 1967; Updyke 1977), a respiration inhibitor (Dhalla, Malhotra, and Sastry 1961), an antifibrillator (Madan, Arora, and Kapila 1960), and, in frogs, a cardiac depressant (Bose et al. 1960) and an inducer of positive and negative inotropic effects (Agarwal et al. 1956).

Further research on laboratory animals has shown the dried *Acorus* rhizome to be inactive as an antispasmodic, an antihistamine (Mokkhasamit et al. 1971), an anticonvulsant (Bhakuni et al. 1969; Dandiya and Cullumbine 1959; Maj, Lastowski, and Lukowski 1965), an antipyretic (Nikonorow 1939), a smooth muscle relaxant (Dandiya and Cullumbine 1959) or a neuroleptic effect enhancer (Dey, Bose, and Mitra 1976). Studies on the antihistamine (Keller, Odenthal, and Leng-Peschlow 1985) and anticonvulsant activity (Madan, Arora, and Kapila 1960) yielded mixed results.

The dried rhizome showed negative results when tested as an antihypoglycemic agent (Bhakuni et al. 1969), a cytotoxic agent (Bhakuni et al. 1969; May and Willuhn 1978), a hypotensive (Bhakuni et al. 1969), an analgesic (Bhakuni et al. 1969; Chow, Chen, and Yang 1976), a diuretic

(Bhakuni et al. 1969; Maj, Lastowski, and Lukowski 1965), a circulation stimulant (Ohmoto et al. 1985), a plaque suppressant (Namba et al. 1985), an anti-implantation agent (Dhar, Gupta, and Chandhoke 1978), an embryotoxin (Prakash 1986), a barbiturate (Dandiya, Cullumbine, and Sellers 1959), a smooth muscle stimulant (Dandiya and Cullumbine 1959), an irritant, a photosensitizer, a skin sensitizer, or an enhancer of cutaneous absorption (Updyke 1977).

Conclusions

Sweet flag has had a long history and numerous traditional economic and ethnobotanical applications. Its story dates back to the time in the Bible when Moses used the plant in a holy anointing oil. Sweet flag was included in many of the early herbals and has a rich history in the Chinese and Indian cultures. Very few plants have gained such widespread use in diverse cultures. This suggests that the pleasantness of aromatic constituents or the positive medicinal attributes associated with sweet flag had enough validity to allow its use to surpass cultural barriers and gain widespread usage.

Contemporary use involves the alkaloids and oils produced mainly in the rhizome. They have been tested on many microorganisms and conditions that the plant has been used to treat and there are indications that the plant may have applications for some ailments for which the plant has a historical record of use. Although further testing is needed, it appears, based on the evidence of these studies and historical use, that sweet flag may still have some beneficial applications in modern medicine.

Sweet flag is used today in perfumes, potpourris, and in flavoring alcoholic beverages and vinegar. But the use is limited due to the carcinogenic alkaloid β-asarone present in the extract. The diploid varieties have been found to be "asarone free," so by proper horticultural selection of quality oil producing diploid varieties, the use of the oil as a flavoring agent could increase its production and use to the levels it maintained prior to the U.S. and Canadian prohibition of the oil.

Its oils are being employed as antifungal and antibacterial agents which suggests further investigation for commercial exploitation as an organic pesticide. Its medicinal values, its use as a flavoring ingredient, and as a natural pesticide are areas in which continuing research is needed, and could prove valuable to medicine and agriculture.

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Book Review

Wild Plants of Barbados. Sean Carrington. 1993. The Macmillan Press Ltd., London and Basingstoke. 128 pp. (paperback). $20.00 ISBN 0-333-56560-6.

This excellent reference brings a fresh and clear approach to the flora of a Caribbean island. There are two useful maps, the first of Barbados showing the plant communities found on the island, and the second showing the New World geographic zones used to define distribution of plants described in this book.

Wild Plants of Barbados starts with a historical review of the flora of Barbados, and then goes through an orderly process of how to use this work. Plant classification is based on the system used by Engler and Prantl, and this is made easy by the author's description of family characteristics, along with an easy-to-read layout of information for each plant entry.

What follows is a clear and informative 'mini botanical' course as the author guides the reader through the steps required to identify a plant. These steps are accompanied by clear line drawings. An added feature is the author's simple approach toward recognizing major plant groups and key families. While he follows the traditional botanical format of plant classification, he makes the process of identification simple enough for even the most uninitiated of readers. This introduction is useful in itself as an outdoor class, which indeed the author teaches as Senior Lecturer in Plant Biology at the University of the West Indies in Barbados.

The author makes the descriptions of each plant simple enough to avoid having to constantly refer to the Glossary at the back of the book. Also included are interesting notes about the uses of the plants. In addition, the reader is given a 'Quick Guide' through some of the major plant families and their particular characteristics, which is especially useful when one is trying to identify several plants at once. The photographs are all exceptionally clear and of a consistently fine quality.

There is a useful Reference section in the back of the book. The author has provided an Appendix for the reader who wishes to compare the coverage in this reference with that in *Flora of Barbados* (now out of print). Carrington has expressed the hope that the prevailing attitude of dismissing the plants around us as 'just bush' will change to one of 'renewed interest and respect' with this book. I believe that he will succeed in this endeavor.

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